



UNITED STATES PATENT AND TRADEMARK OFFICE

94
UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/044,690

01/09/2002

Chris Wilkerson

042390.P11928

9705

8791

7590

06/07/2006

BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

EXAMINER

YIGDALL, MICHAEL J

ART UNIT

PAPER NUMBER

2192

DATE MAILED: 06/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/044,690	Applicant(s) WILKERSON ET AL.	
	Examiner Michael J. Yigdall	Art Unit 2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 March 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This Office action is responsive to Applicant's submission filed on March 21, 2006.

Claims 1-29 are pending.

Response to Arguments

2. Applicant's arguments have been fully considered but they are not persuasive.

Applicant states that it would be impermissible hindsight to combine Fu and Emma (remarks, page 10), and likewise that it would be impermissible hindsight to combine Fu and Damron (remarks, page 11).

However, Applicant has not provided support for these conclusions. Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from Applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In each of the above cases, a teaching, suggestion or motivation to combine the references, found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, was set forth in the Office action.

Applicant states that even if Fu and Emma were combined, "such a combination would lack predicting of the outcome of the first instruction that involves inserting a third instruction to be executed after the second instruction and before the first instruction, wherein the third instruction is to retrieve a predicted outcome of the first instruction from the software structure

using the outcome of the second instruction as the key into the software structure, as recited in amended claim 1” (remarks, page 10).

However, the combination of Fu and Emma teaches these elements, as set forth below. Applicant’s argument is merely a statement with no analysis or reasoning to show how the language of the claims distinguishes over the references. See 37 CFR 1.111(b) and (c).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-9, 14-19, 21-25 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over “Value Speculation Scheduling for High Performance Processors” by Fu et al. (art of record, “Fu”) in view of U.S. Patent No. 4,763,245 to Emma et al. (art of record, “Emma”).

With respect to claim 1 (currently amended), Fu discloses a method comprising:

(a) creating a data flow graph associated with a program (see, for example, page 266, Figure 7, step 3, which shows creating a data dependence or data flow graph);

(b) identifying a first instruction that is to be executed after a second instruction (see, for example, page 263, column 2, lines 1-3 and Figure 3(a), which shows an instruction I4, i.e. a first instruction, that is to be executed after an instruction I3, i.e. a second instruction);

(c) determining that an outcome of the first instruction is dependent on an outcome of the second instruction based on the data flow graph (see, for example, page 263, column 2, lines 7-9 and page 264, Figure 4(a), which shows that an outcome of the first instruction I4 is dependent on an outcome of the second instruction I3).

Although Fu does not expressly disclose the limitation wherein the outcome of the second instruction represents a key into a software structure that includes a set of keys representing various outcomes of the second instruction and a corresponding set of predicted outcomes of the first instruction, Fu does, however, disclose a table of predicted values in which each entry in the table has an index or key (see, for example, page 264, column 1, lines 29-33). The values in the table represent predicted operands of the first instruction I4, based on predicted outcomes of the second instruction I3, and enable the first instruction I4 to be speculated (see, for example, page 264, column 1, lines 6-13).

Furthermore, Emma discloses a data-dependent branch table (DDBT) for predicting the outcome of a branch instruction based on its operands (see, for example, column 3, lines 64-67). The branch instruction is a first instruction whose operands depend on an outcome of a second instruction, such as a store instruction that changes a condition code (see, for example, column 5, lines 20-27). The operands (i.e., the outcomes of the second instruction) represent keys in the DDBT that correspond to the predicted outcomes of the branch instruction (see, for example, column 6, lines 35-59).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to supplement the prediction method of Fu with a software structure that includes a set of keys representing various outcomes of the second instruction and a corresponding set of

predicted outcomes of the first instruction, such as the data-dependent branch table of Emma, so as to predict, for example, the outcomes of branch instructions and thus improve execution performance (see, for example, Emma, column 1, lines 12-31).

Fu in view of Emma further discloses:

(d) predicting the outcome of the first instruction, the predicting comprising inserting a third instruction to be executed after the second instruction and before the first instruction (see, for example, Fu, page 263, Figure 3(b), which shows inserting an instruction I7, i.e. a third instruction, after the second instruction I3 and before the first instruction I4), wherein the third instruction is to retrieve a predicted outcome of the first instruction from the software structure using the outcome of the second instruction as the key into the software structure (see, for example, Fu, page 264, column 1, lines 10-15, which shows that the third instruction I7 retrieves a predicted value from the table, and see, for example, Emma, column 6, lines 35-59, which shows that the operand, i.e. outcome of the second instruction, is the key into the table).

As noted above, while Fu discloses speculating the first instruction I4, the teachings of Emma suggest predicting the outcomes of such first instructions (e.g., branch instructions).

With respect to claim 2 (original), the rejection of claim 1 is incorporated, and Fu in view of Emma further discloses the limitation wherein the second instruction precedes the first instruction during the execution of the program by one or more intermediate instructions (see, for example, Fu, page 263, Figure 3(a) and page 264, Figure 4(a), which shows that a second instruction such as I1, an instruction on which the first instruction I4 depends, may precede the first instruction I4 by one or more intermediate instructions).

With respect to claim 3 (original), the rejection of claim 1 is incorporated, and Fu in view of Emma further discloses the limitation wherein the software structure is a lookup table (see, for example, Fu, page 264, column 1, lines 29-33, which shows an indexed table, i.e. a lookup table).

With respect to claim 4 (original), the rejection of claim 1 is incorporated, and Fu in view of Emma further discloses the limitation wherein each predicted outcome in the software structure is an outcome resulted from a last execution of the first instruction when an outcome of the second instruction was equal to a key associated with said each predicted outcome in the software structure (see, for example, Fu, page 265, column 1, lines 16-18, which shows that the predicted value is the last value, i.e. an outcome resulted from the last execution).

With respect to claim 5 (original), the rejection of claim 4 is incorporated, and Fu in view of Emma further discloses:

(a) inserting a fourth instruction to be executed after the first instruction (see, for example, Fu, page 263, Figure 3(b), which shows inserting an instruction I9, i.e. a fourth instruction, after the first instruction I4), the fourth instruction is to update the software structure with the value resulted from the execution of the first instruction with the corresponding outcome of the second instruction (see, for example, Fu, page 264, column 1, lines 15-18, which shows that the fourth instruction I9 updates the table with the resulting value).

With respect to claim 6 (original), the rejection of claim 1 is incorporated, and Fu in view of Emma further discloses the limitation wherein the first instruction is a branch instruction (see, for example, Emma, column 5, lines 20-27).

With respect to claim 7 (original), the rejection of claim 6 is incorporated, and Fu in view of Emma further discloses the limitation wherein the branch instruction is any one of an indirect branch instruction and a direct branch instruction (see, for example, Emma, column 5, lines 20-27, which shows that the branch instruction is a direct branch instruction).

With respect to claim 8 (original), the rejection of claim 6 is incorporated, and Fu in view of Emma further discloses the limitation wherein the outcome of the second instruction is a value that determines the outcome of the first instruction (see, for example, Fu, page 263, Figure 3(a), which shows that the outcome of the second instruction I3 is a value, stored in R4, that determines the outcome of the first instruction I4).

With respect to claim 9 (original), the rejection of claim 1 is incorporated, and Fu in view of Emma further discloses the limitation wherein the outcome of the second instruction is a data address of a value that determines the outcome of the first instruction (see, for example, Fu, page 263, Figure 3(a), which shows that the outcome of a second instruction I2 is a data address of a value, subsequently stored in R4 by instruction I3, that determines the outcome of the first instruction I4).

With respect to claim 14 (currently amended), the apparatus recited in the claim corresponds to the method recited in claim 1 (therefore, see the rejection of claim 1 above). Note that Fu further discloses a compiler (see, for example, page 267, column 2, lines 8-18).

With respect to claims 15-19 (original), the limitations recited in the claims are analogous to the limitations recited in claims 2-6, respectively (therefore, see the rejections of claims 2-6 above, respectively).

With respect to claim 21 (currently amended), the system recited in the claim corresponds to the method recited in claim 1 (therefore, see the rejection of claim 1 above). Note that Fu further discloses a compiler (see, for example, page 267, column 2, lines 8-18). A memory and a processor are inherently provided to store and execute the compiler, respectively, without which the prediction method of Fu and Emma would be inoperative.

With respect to claims 22-25 (original), the limitations recited in the claims are analogous to the limitations recited in claims 2 and 4-6, respectively (therefore, see the rejections of claims 2 and 4-6 above, respectively).

With respect to claim 27 (currently amended), the computer readable medium recited in the claim corresponds to the method recited in claim 1 (therefore, see the rejection of claim 1 above).

With respect to claims 28 and 29 (original), the limitations recited in the claim are analogous to the limitations recited in claims 2 and 6, respectively (therefore, see the rejection of claims 2 and 6 above, respectively).

5. Claim 10-13, 20 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fu in view of Emma, as applied to claims 1, 14 and 21 above, respectively, and further in view of U.S. Patent No. 6,687,807 to Damron (art of record, "Damron").

With respect to claim 10 (original), the rejection of claim 1 is incorporated. Fu in view of Emma does not expressly disclose the limitation wherein the first instruction is a linked list instruction.

However, Damron discloses efficiently generating prefetch instructions for pointer-based data structures (see, for example, column 2, lines 43-48), such as linked lists (see, for example, column 2, lines 12-15), so as to mitigate memory latency problems (see, for example, column 2, lines 2-5). Damron discloses that the additional memory hardware of the invention is relatively small and provides the CPU with relatively fast access (see, for example, column 2, lines 62-67).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to supplement the prediction method of Fu and Emma with the prefetching and linked list features taught by Damron, so as to predict the outcomes of linked list instructions, and accordingly mitigate the memory latency problems associated such pointer-based data structures.

With respect to claim 11 (original), the rejection of claim 10 is incorporated, and Fu in view of Emma in view of Damron further discloses the limitations wherein:

- (a) each key in the software structure is a pointer to a producer item in a linked list (see, for example, Fu, page 264, column 1, lines 29-33 and page 266, column 2, lines 30-34, which shows that the index or key in the table corresponds or points to an instruction selected for value prediction, i.e. a producer instruction, such as a producer item in a linked list); and
- (b) a predicted outcome corresponding to said each key in the software structure is a predicted pointer to a target item in the linked list (see, for example, Fu, page 263, Figure 3(a),

which shows that the outcome of an instruction I2 is a data address of a target value, i.e. a pointer to a target value, such as a pointer to a target item in the linked list);

(c) wherein the producer item precedes the target item in the linked list by one or more intermediate items (see, for example, Fu, page 263, Figure 3(a) and page 264, Figure 4(a), which shows that an instruction such as a producer item may precede an instruction such as a target item by one or more intermediate instructions).

With respect to claim 12 (original), the rejection of claim 11 is incorporated, and Fu in view of Emma in view of Damron further discloses the limitations wherein:

(a) the third instruction is to retrieve the predicted pointer of the target item from the software structure (see, for example, Fu, page 264, column 1, lines 14-15, which shows that the third instruction I7 retrieves the predicted value from the table); and

(b) the third instruction is to be executed in parallel with one or more instructions that obtain pointers to the one or more intermediate items (see, for example, Fu, page 263, column 2, lines 14-18 and page 264, Figure 4(b), which shows that the third instruction I7 is executed in parallel).

With respect to claim 13 (original), the rejection of claim 10 is incorporated, and Fu in view of Emma in view of Damron further discloses the limitations wherein:

(a) each key in the software structure is a value of a producer item in a linked list (see, for example, Fu, page 264, column 1, lines 29-33 and page 266, column 2, lines 30-34, which shows that the index or key in the table is a value corresponding to an instruction selected for value prediction, i.e. a producer instruction, such as a producer item in a linked list); and

(b) a predicted outcome corresponding to said each key in the software structure is a predicted value of a target item in the linked list (see, for example, Fu, page 263, Figure 3(a), which shows that the outcome of an instruction I3 is a target value, such as a value of target item in the linked list);

(c) wherein the producer item precedes the target item in the linked list by at least one intermediate item (see, for example, Fu, page 263, Figure 3(a) and page 264, Figure 4(a), which shows that an instruction such as a producer item may precede an instruction such as a target item by at least one intermediate instruction).

With respect to claim 20 (original), the limitations recited in the claim are analogous to the limitations recited in claim 10 (therefore, see the rejection of claim 10 above).

With respect to claim 26 (original), the limitations recited in the claim are analogous to the limitations recited in claim 10 (therefore, see the rejection of claim 10 above).

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael J. Yigdall whose telephone number is (571) 272-3707. The examiner can normally be reached on Monday through Friday from 7:30am to 4:00pm.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MJY

Michael J. Yigdall
Examiner
Art Unit 2192

mjy


TUAN DAM
SUPERVISORY PATENT EXAMINER